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Shaft Design on Strength Basis Formulas

Calculators! Examples! Conversions!

List of 16 Shaft Design on Strength Basis Formulas

Shaft Design on Strength Basis

1) Axial Force given Tensile Stress in Shaft

Open Calculator

fx $$P_{ax} = \sigma_t \cdot \pi \cdot \frac{d^2}{4}$$

ex $$125767.1\text{N} = 72.8\text{N/mm}^2 \cdot \pi \cdot \frac{(46.9\text{mm})^2}{4}$$

2) Bending Moment given Bending Stress Pure Bending

Open Calculator

fx $$M_b = \frac{\sigma_b \cdot \pi \cdot d^3}{32}$$

ex $$1.8\text{E\^{}6N*mm} = \frac{177.8\text{N/mm}^2 \cdot \pi \cdot (46.9\text{mm})^3}{32}$$

3) Bending Stress given Normal Stress

Open Calculator

fx $$\sigma_b = \sigma_x - \sigma_t$$

ex $$177.8\text{N/mm}^2 = 250.6\text{N/mm}^2 - 72.8\text{N/mm}^2$$

4) Bending Stress in Shaft Pure Bending Moment

Open Calculator

fx $$\sigma_b = \frac{32 \cdot M_b}{\pi \cdot d^3}$$

ex $$177.8\text{N/mm}^2 = \frac{32 \cdot 1800736.547\text{N*mm}}{\pi \cdot (46.9\text{mm})^3}$$

5) Diameter of Shaft given Bending Stress Pure Bending

Open Calculator

fx $$d = \left(\frac{32 \cdot M_b}{\pi \cdot \sigma_b}\right)^{\frac{1}{3}}$$

ex $$46.9\text{mm} = \left(\frac{32 \cdot 1800736.547\text{N*mm}}{\pi \cdot 177.8\text{N/mm}^2}\right)^{\frac{1}{3}}$$

6) Diameter of Shaft given Tensile Stress in Shaft

Open Calculator

fx $$d = \sqrt{4 \cdot \frac{P_{ax}}{\pi \cdot \sigma_t}}$$

ex $$46.90001\text{mm} = \sqrt{4 \cdot \frac{125767.1\text{N}}{\pi \cdot 72.8\text{N/mm}^2}}$$

7) Diameter of Shaft given Torsional Shear Stress in Shaft Pure Torsion

Open Calculator

$$d = \left(16 \cdot \frac{Mt_{shaft}}{\pi \cdot \tau}\right)^{\frac{1}{3}}$$

$$46.9\text{mm} = \left(16 \cdot \frac{329966.2\text{N*mm}}{\pi \cdot 16.29\text{N/mm}^2}\right)^{\frac{1}{3}}$$

8) Maximum Shear Stress in Shaft Bending and Torsion

Open Calculator

$$\tau_{smax} = \sqrt{\left(\frac{\sigma_x}{2}\right)^2 + \tau^2}$$

$$126.3545\text{N/mm}^2 = \sqrt{\left(\frac{250.6\text{N/mm}^2}{2}\right)^2 + (16.29\text{N/mm}^2)^2}$$

9) Normal Stress given Both Bending and Torsional act on Shaft

Open Calculator

$$\sigma_x = \sigma_b + \sigma_t$$

$$250.6\text{N/mm}^2 = 177.8\text{N/mm}^2 + 72.8\text{N/mm}^2$$

10) Normal Stress given Principal Shear Stress in Shaft Bending and Torsion

Open Calculator

$$\sigma_x = 2 \cdot \sqrt{\tau_{max}^2 - \tau^2}$$

$$250.6011\text{N/mm}^2 = 2 \cdot \sqrt{(126.355\text{N/mm}^2)^2 - (16.29\text{N/mm}^2)^2}$$

11) Power transmitted by Shaft

Open Calculator

$$P = 2 \cdot \pi \cdot N \cdot M_t$$

$$8.834159\text{kW} = 2 \cdot \pi \cdot 1850\text{rev/min} \cdot 45600\text{N*mm}$$

12) Tensile Stress given Normal Stress

Open Calculator

$$\sigma_t = \sigma_x - \sigma_b$$

$$72.8\text{N/mm}^2 = 250.6\text{N/mm}^2 - 177.8\text{N/mm}^2$$

13) Tensile Stress in Shaft when it is Subjected to Axial Tensile Force

Open Calculator

$$\sigma_t = 4 \cdot \frac{P_{ax}}{\pi \cdot d^2}$$

$$72.80002\text{N/mm}^2 = 4 \cdot \frac{125767.1\text{N}}{\pi \cdot (46.9\text{mm})^2}$$

14) Torsional Moment given Torsional Shear Stress in Shaft Pure Torsion

Open Calculator

$$Mt_{shaft} = \tau \cdot \pi \cdot \frac{d^3}{16}$$

$$329966.2\text{N*mm} = 16.29\text{N/mm}^2 \cdot \pi \cdot \frac{(46.9\text{mm})^3}{16}$$

15) Torsional Shear Stress given Principal Shear Stress in Shaft

Open Calculator

fx $$\tau = \sqrt{\tau_{max}^2 - \left(\frac{\sigma_x}{2}\right)^2}$$

ex $$16.29405\text{N/mm}^2 = \sqrt{(126.355\text{N/mm}^2)^2 - \left(\frac{250.6\text{N/mm}^2}{2}\right)^2}$$

16) Torsional Shear Stress in Shaft Pure Torsion

Open Calculator

fx $$\tau = 16 \cdot \frac{Mt_{shaft}}{\pi \cdot d^3}$$

ex $$16.29\text{N/mm}^2 = 16 \cdot \frac{329966.2\text{N*mm}}{\pi \cdot (46.9\text{mm})^3}$$

Variables Used

- **d** Diameter of Shaft on Strength Basis *(Millimeter)*
- **M_b** Bending Moment in Shaft *(Newton Millimeter)*
- **M_t** Torque Transmitted by Shaft *(Newton Millimeter)*
- **Mt_{shaft}** Torsional Moment in Shaft *(Newton Millimeter)*
- **N** Speed of Shaft *(Revolution per Minute)*
- **P** Power Transmitted by Shaft *(Kilowatt)*
- **P_{ax}** Axial Force on Shaft *(Newton)*
- **σ_b** Bending Stress in Shaft *(Newton per Square Millimeter)*
- **σ_t** Tensile Stress in Shaft *(Newton per Square Millimeter)*
- **σ_x** Normal Stress in Shaft *(Newton per Square Millimeter)*
- **τ_{max}** Principal Shear Stress in Shaft *(Newton per Square Millimeter)*
- **τ_{smax}** Maximum Shear Stress in Shaft *(Newton per Square Millimeter)*
- τ Torsional Shear Stress in Shaft *(Newton per Square Millimeter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Power** in Kilowatt (kW)
  Power Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Frequency** in Revolution per Minute (rev/min)
  Frequency Unit Conversion
- Measurement: **Torque** in Newton Millimeter (N*mm)
  Torque Unit Conversion
- Measurement: **Stress** in Newton per Square Millimeter (N/mm²)
  Stress Unit Conversion

Check other formula lists

- **Maximum Shear Stress and Principal Stress Theory Formulas**
- **Shaft Design on Strength Basis Formulas**

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